CLAIMS

1. Filtering method adapted to transform an input digital signal (x_n) into one or more output digital signals (y_n) having even-indexed samples (y_{2n}) and odd-indexed samples (y_{2n+1}), said method including at least one iteration (506) which contains

- an operation of modifying even-indexed samples (y_{2n}) by a function (R) of weighted odd-indexed samples ($\alpha_{0,j}.y_{2n+m_j}$),

- an operation of modifying odd-indexed samples (y_{2n+1}) by a function (R) of weighted even-indexed samples ($\beta_{0,j}.(y_{2n} - y_{2n+2})$),

said weighted samples being obtained by at least one weighting operation,

said method being characterised in that at least one of said weighting operations is applied to the difference between two consecutive even-indexed samples.

2. Filtering method according to Claim 1, characterised in that said operation of modifying odd-indexed samples (y_{2n+1}) is performed following said operation of modifying even-indexed samples (y_{2n}).

3. Filtering method according to Claim 1 or 2, characterised in that said iteration (506) consists notably of:

- weighting, by means of a first weighting coefficient ($\alpha_{0,j}$), at least one odd-indexed sample (y_{2n+m_j}) adjacent to an even-indexed sample currently being modified, so as to obtain a weighted odd-indexed sample ($\alpha_{0,j}.y_{2n+m_j}$),

- modifying at least one even-indexed sample (y_{2n}) using at least one weighted odd-indexed sample ($\alpha_{0,j}.y_{2n+m_j}$),

- weighting, by means of a second weighting coefficient ($\beta_{0,j}$), even-indexed samples ($y_{2n} - y_{2n+2}$) adjacent to an odd-indexed sample currently

being modified, so as to obtain weighted even-indexed samples $(\beta_{0,j}.(y_{2n} - y_{2n+2}))$, and

- modifying at least one odd-indexed sample (y_{2n+1}) using at least one weighted even-indexed sample $(\beta_{0,j}.(y_{2n} - y_{2n+2}))$.

4. Filtering method according to the preceding claim, characterised in that the second weighting coefficient $(\beta_{0,j})$ is a function of the first weighting coefficient $(\alpha_{0,j})$.

5. Filtering method according to the preceding claim, characterised in that the second weighting coefficient $(\beta_{0,j})$ depends on the first weighting coefficient $(\alpha_{0,j})$ as follows:

$$\beta_{0,j} = m_j / \left(1 - 2\sum_{i=0}^{j} \alpha_{0,i}\right)$$

where $\alpha_{0,i}$ designates the first weighting coefficient, $\beta_{0,j}$ designates the second weighting coefficient, i and j are integers and m_j is a value defined by the recurrence $m_0 = (-1)^{L_0}$ and $m_j = -m_{j-1}$, L_0 being a predetermined integer.

6. Filtering method according to any one of the preceding claims, characterised in that, at each iteration, the odd-indexed sample (y_{2n+m_j}) adjacent to the even sample currently being modified is alternately the sample of rank immediately below (y_{2n-1}) or immediately above (y_{2n+1}).

7. Filtering method according to any one of the preceding claims, characterised in that it includes, at the end of said iteration (506), an additional filtering step (508) including an operation of weighting by means of a third weighting coefficient (γ).

8. Filtering method according to the preceding claim, characterised in that the third weighting coefficient (γ) is a function of the weighting coefficient used at the preceding step, as follows:

$$\gamma = -1/\left(2\beta_{0,L_0} - 1\right)$$

where γ designates the third weighting coefficient, L_0 is a predetermined parameter and β_{0,L_0-1} designates the weighting coefficient used at the preceding step.

9. Filtering method according to any one of the preceding claims, characterised in that the digital input signal (x_n) represents an image.

10. Filtering method adapted to transform one or more input digital signals (y_n) into an output digital signal (x_n), said input signals including even-indexed samples (y_{2n}) and odd-indexed samples (y_{2n+1}), said method including at least one iteration (618) which contains

- an operation of modifying odd-indexed samples (x_{2n+1}) by means of a function (R) of weighted even-indexed samples ($\beta_{0,j}.(x_{2n}-x_{2n+2})$),

- an operation of modifying even-indexed samples (x_{2n}) by means of a function (R) of weighted odd-indexed samples ($\alpha_{0,j}.(x_{2n+m_j})$),

said weighted samples being obtained by means of at least one weighting operation,

said method being characterised in that at least one of said weighting operations is applied to the difference between two consecutive even-indexed samples.

11. Filtering method according to the preceding claim, characterised in that said operation of modifying even-indexed samples (x_{2n}) is performed following said operation of modifying odd-indexed samples (x_{2n+1}).

12. Filtering method according to Claim 10 or 11, characterised in that said iteration (618) consists notably of:

- weighting, by means of a fourth weighting coefficient ($\beta_{0,j}$), even-indexed samples ($x_{2n}-x_{2n+2}$) adjacent to an odd sample currently being modified, so as to obtain weighted even-indexed samples ($\beta_{0,j}.(x_{2n}-x_{2n+2})$),

- modifying at least one odd-indexed sample (x_{2n+1}) using at least one weighted even-indexed sample ($\beta_{0,j}.(x_{2n}-x_{2n+2})$),

- weighting, by means of a fifth weighting coefficient($\alpha_{0,j}$), at least one odd-indexed sample (x_{2n+m_j}) adjacent to an even sample currently being modified, so as to obtain a weighted odd-indexed sample ($\alpha_{0,j}.x_{2n+m_j}$), and

- modifying at least one even-indexed sample (x_{2n}) using at least one weighted odd-indexed sample ($\alpha_{0,j}.x_{2n+m_j}$).

13. Filtering method according to the preceding claim, characterised in that the fourth weighting coefficient ($\beta_{0,j}$) is a function of the fifth weighting coefficient ($\alpha_{0,j}$).

14. Filtering method according to the preceding claim, characterised in that the fourth weighting coefficient ($\beta_{0,j}$) depends on the fifth weighting coefficient ($\alpha_{0,j}$) as follows:

$$\beta_{0,j} = m_j / \left(1 - 2 \sum_{i=0}^{j} \alpha_{0,i} \right)$$

where $\alpha_{0,i}$ designates the fifth weighting coefficient, $\beta_{0,j}$ designates the fourth weighting coefficient, i and j are integers and m_j is a value defined by the recurrence $m_0 = (-1)^{L_0}$ and $m_j = -m_{j-1}$, L_0 being a predetermined integer.

15. Filtering method according to any one of Claims 10 to 14, characterised in that, at each iteration, the odd-indexed sample (x_{2n+m_j}) adjacent to the even sample currently being modified is alternately the sample of rank immediately below (x_{2n-1}) or immediately above (x_{2n+1}).

16. Filtering method according to any one of Claims 10 to 15, characterised in that it includes, prior to said iteration (618), an additional filtering step (614) including an operation of weighting by means of a sixth weighting coefficient (γ).

17. Filtering method according to the preceding claim, characterised in that the sixth weighting coefficient (γ) is a function of the weighting coefficient used at the following step, as follows:

$$\gamma = -1/(2\beta_{0,L_0} - 1)$$

where γ designates the sixth weighting coefficient, L_0 is a predetermined parameter and β_{0,L_0-1} designates the weighting coefficient used at the following step.

18. Filtering method according to any one of Claims 10 to 17, characterised in that the digital output signal (x_n) represents an image.

19. Filtering method according to any one of the preceding claims, characterised in that the said modification operations consist of applying an approximation function (R).

20. Filtering method according to the preceding claim, characterised in that the approximation function (R) is the identity function.

21. Filtering method according to Claim 19, characterised in that the approximation function (R) is a function of a real variable which supplies the closest integer to the variable.

22. Filtering method according to Claim 19, characterised in that the approximation function (R) is a function of a real variable which supplies the first integer below the variable.

23. Filtering method according to Claim 19, characterised in that the approximation function (R) is a function of a real variable which supplies the first integer above the variable.

24. Filtering method according to Claim 19, characterised in that the approximation function (R) is a function of a variable decomposed into sub-variables whose sum is equal to the variable, which supplies a sum of approximate values of the sub-variables, each of the approximate values of the sub-variables being, either a function of a real variable which supplies the integer closest to the variable, or a function of a real variable which supplies the first integer below the variable, or a function of a real variable which supplies the first integer above the variable.

25. Signal processing device (10), characterised in that it has means adapted to implement a filtering method according to any one of the preceding claims.

26. Digital filtering device adapted to transform an input digital signal (x_n) into one or more output digital signals (y_n) containing even-indexed samples (y_{2n}) and odd-indexed samples (y_{2n+1}), said filtering device having

- at least one weighting module,
- means for modifying even-indexed samples (y_{2n}) by means of a function (R) of weighted odd-indexed samples ($\alpha_{0,j}.y_{2n+m_j}$),
- means for modifying odd-indexed samples (y_{2n+1}) by means of a function of weighted even-indexed samples ($\beta_{0,j}.(y_{2n} - y_{2n+2})$),

said weighted samples being supplied by said weighting means, said modification means functioning iteratively, so as to modify even-indexed samples (y_{2n}) at least once and then odd-indexed samples (y_{2n+1}) at least once, said filtering device being characterised in that at least one of said weighting means receives as an input the difference between two consecutive even-indexed samples.

27. Filtering device according to the preceding claim, characterised in that said means for modifying odd-indexed samples (y_{2n+1}) are disposed downstream of said means for modifying even-indexed samples (y_{2n}).

28. Filtering device according to Claim 26 or 27, characterised in that it has:

- means for weighting, by means of a first weighting coefficient ($\alpha_{0,j}$), at least one odd-indexed sample (y_{2n+m_j}) adjacent to an even sample currently being modified, so as to obtain a weighted odd-indexed sample ($\alpha_{0,j}.y_{2n+m_j}$),
- means for modifying at least one even-indexed sample (y_{2n}) from at least one weighted odd-indexed sample ($\alpha_{0,j}.y_{2n+m_j}$),
- means for weighting, by means of a second weighting coefficient ($\beta_{0,j}$), even-indexed samples ($y_{2n} - y_{2n+2}$) adjacent to an odd sample currently being modified, so as to obtain weighted even-indexed samples ($\beta_{0,j}.(y_{2n} - y_{2n+2})$), and

- means for modifying at least one odd-indexed sample (y_{2n+1}) using at least one weighted even-indexed sample ($\beta_{0,j}.(y_{2n} - y_{2n+2})$).

29. Filtering device according to the preceding claim, characterised in that the second weighting coefficient ($\beta_{0,j}$) is a function of the first weighting coefficient ($\alpha_{0,j}$).

30. Filtering device according to the preceding claim, characterised in that the second weighting coefficient ($\beta_{0,j}$) depends on the first weighting coefficient ($\alpha_{0,j}$) as follows:

$$\beta_{0,j} = m_j / \left(1 - 2 \sum_{i=0}^{j} \alpha_{0,i} \right)$$

where $\alpha_{0,i}$ designates the first weighting coefficient, $\beta_{0,j}$ designates the second weighting coefficient, i and j are integers and m_j is a value defined by the recurrence $m_0 = (-1)^{L_0}$ and $m_j = -m_{j-1}$, L_0 being a predetermined integer.

31. Filtering device according to any one of Claims 26 to 30, characterised in that, at each iteration, the odd-indexed sample (y_{2n+m_j}) adjacent to the even sample currently being modified is alternately the sample of rank immediately below (y_{2n-1}) or immediately above (y_{2n+1}).

32. Filtering device according to any one of Claims 26 to 31, characterised in that it has additional filtering means including means of weighting by means of a third weighting coefficient (γ).

33. Filtering device according to the preceding claim, characterised in that the third weighting coefficient (γ) is a function of a weighting coefficient used upstream of said additional filtering means, as follows:

$$\gamma = -1/(2\beta_{0,L_0-1})$$

where γ designates the third weighting coefficient, L_0 is a predetermined parameter and β_{0,L_0-1} designates the weighting coefficient used upstream of said additional filtering means.

34. Filtering device according to any one of Claims 26 to 33, characterised in that the input digital signal (x_n) represents an image.

35. Digital filtering device adapted to transform one or more input digital signals (y_n) into an output digital signal (x_n), said input signals containing even-indexed samples (x_{2n}) and odd-indexed samples (x_{2n+1}), said filtering device having

- at least one weighting means,
- means for modifying odd-indexed samples (x_{2n+1}) by means of a function of weighted even-indexed samples ($\beta_{0,j}.(x_{2n} - x_{2n+2})$),
- means for modifying even-indexed samples (x_{2n}) by means of a function (R) of weighted odd-indexed samples ($\alpha_{0,j}.x_{2n+m_j}$),

said weighted samples being supplied by said weighting means, said modification means functioning iteratively, so as to modify odd-indexed samples (x_{2n+1}) at least once and then even-indexed samples (x_{2n}) at least once,
said filtering device being characterised in that at least one of said weighting means receives as an input the difference between two consecutive even-indexed samples.

36. Filtering device according to the preceding claim, characterised in that said means for modifying even-indexed samples (x_{2n}) are disposed downstream of said means for modifying odd-indexed samples (x_{2n+1}).

37. Filtering device according to Claim 35 or 36, characterised in that it has:

- means for weighting, by means of a fourth weighting coefficient ($\beta_{0,j}$), even-indexed samples ($x_{2n} - x_{2n+2}$) adjacent to an odd sample currently being modified, so as to obtain weighted even-indexed samples ($\beta_{0,j}.(x_{2n} - x_{2n+2})$),
- means for modifying at least one odd-indexed sample (x_{2n+1}) using at least one weighted even-indexed sample ($\beta_{0,j}.(x_{2n} - x_{2n+2})$),
- means for weighting, by means of a fifth weighting coefficient ($\alpha_{0,j}$), at least one odd-indexed sample (x_{2n+m_j}) adjacent to an even sample currently being modified, so as to obtain a weighted odd-indexed sample ($\alpha_{0,j}.y_{2n+m_j}$) and

- means for modifying at least one even-indexed sample (y_{2n}) using at least one weighted odd-indexed sample ($\alpha_{0,j}.x_{2n+m_j}$).

38. Filtering device according to the preceding claim, characterised in that the fourth weighting coefficient ($\beta_{0,j}$) is a function of the fifth weighting coefficient ($\alpha_{0,j}$).

39. Filtering device according to the preceding claim, characterised in that the fourth weighting coefficient ($\beta_{0,j}$) depends on the fifth weighting coefficient ($\alpha_{0,j}$) as follows:

$$\beta_{0,j} = m_j / \left(1 - 2 \sum_{i=0}^{j} \alpha_{0,i} \right)$$

where $\alpha_{0,i}$ designates the fifth weighting coefficient, $\beta_{0,j}$ designates a fourth weighting coefficient, i and j are integers and m_j is a value defined by the recurrence $m_0 = (-1)^{L_0}$ and $m_j = -m_{j-1}$, L_0 being a predetermined integer.

40. Filtering device according to any one of Claims 35 to 39, characterised in that, at each iteration, the odd-indexed sample (x_{2n+m_j}) adjacent to the even sample currently being modified is alternately the sample of rank immediately below (x_{2n-1}) or immediately above (x_{2n+1}).

41. Filtering device according to any one of Claims 35 to 40, characterised in that it also has additional filtering means including means of weighting by means of a sixth weighting coefficient (γ).

42. Filtering device according to the preceding claim, characterised in that the sixth weighting coefficient (γ) is a function of the weighting coefficient used downstream of said additional filtering means, as follows:

$$\gamma = -1/(2\beta_{0,L_0-1})$$

where γ designates the sixth weighting coefficient, L_0 is a predetermined parameter and β_{0,L_0-1} designates the weighting coefficient used downstream of said additional filtering means.

43. Filtering device according to any one of Claims 35 to 42, characterised in that the digital output signal (x_n) represents an image.

44. Filtering device according to any one of Claims 26 to 43, characterised in that said modification means have means for applying an approximation function (R).

45. Filtering device according to the preceding claim, characterised in that the approximation function (R) is the identity function.

46. Filtering device according to Claim 44, characterised in that the approximation function (R) is a function of a real variable which supplies the integer closest to the variable.

47. Filtering device according to Claim 44, characterised in that the approximation function (R) is a function of a real variable which supplies the first integer below the variable.

48. Filtering device according to Claim 44, characterised in that the approximation function (R) is a function of a real variable which supplies the first integer above the variable.

49. Filtering device according to Claim 44, characterised in that the approximation function (R) is a function of a variable decomposed into sub-variables whose sum is equal to the variable, which supplies a sum of approximate values of the sub-variables, each of the approximate values of the sub-variables being, either a function of a real variable which supplies the integer closest to the variable, or a function of a real variable which supplies a first integer below the variable, or a function of a real variable which supplies the first integer above the variable.

50. Signal processing device (2, 5), characterised in that it includes a filtering device according to any one of Claims 26 to 49.

51. Signal processing device (2, 5) including at least two filtering devices according to any one of Claims 26 to 49, the output signal of one of the filtering devices being the input signal of the other filtering device.

52. Digital apparatus, characterised in that it includes a signal processing device according to any one of Claims 25, 50 and 51.

53. Digital photographic apparatus, characterised in that it includes a signal processing device according to any one of Claims 25, 50 and 51.

54. Encoding method, characterised in that it includes steps adapted to implement a filtering method according to any one of Claims 1 to 24.

55. Encoding device, characterised in that it includes at least one filtering device according to any one of Claims 26 to 49.

56. Digital signal compression method, characterised in that it includes steps adapted to implement a filtering method according to any one of Claims 1 to 24.

57. Digital signal compression device, characterised in that it includes at least one filtering device according to any one of Claims 26 to 49.

58. An information storage means, possibly removable, which can be read by a computer or by a microprocessor, and which stores a program, characterised in that it comprises means adapted to implement a filtering method according to any one of Claims 1 to 24.

59. A computer program product, characterised in that it contains sequences of instructions for implementing a filtering method according to any one of Claims 1 to 24.